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The Behavior of Swamp Plants

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EASTERN ILLINOIS STATE NORMAL SCHOOL

The definite relations that exist between plants and the conditions which surround them are of constant interest to those persons who see plants as things which are alive and performing work. One set of conditions makes possible a type of plant life which type must be adopted in a general way, at least by all the plants living among these conditions. That this type is adopted in a general way only is clearly shown by the fact that no two plants, even of the nearest kin, are exactly alike, no matter how nearly identical the conditions which affect them. Plants which live in water need certain structures which plants living on dry land do not need; and those living on the land of the upward slopes of high mountains, to be successful, must have some structures not found among plants living in the valleys below. As an outcome of these diverse conditions we have certain groups of plants which we recognize as mountain-slope plants; certain groups which are valley plants, and others recognized as water plants. Furthermore, some water plants live entirely beneath the water's surface, while others have their leaves floating or standing above the water. Thus we have a group of submerged water plants and a group of floating ones, each group needing structures peculiar to the demands of the conditions which surround it. These various environments have given rise to "plant societies." By this it is not meant that plants of nearest kin nor of greatest resemblances are associated, but those which have been able to respond to a particular environment by developing the structures needed for successful growth in that environment. Any given plant society usually contains species of plants widely separated in relationship, rather than those of closely related families.

A large community in which all the men are blacksmiths would not prosper, since all would demand the same kind of support. Communities of men prosper best when some of the men are blacksmiths, some are merchants, some physicians, and others working in various other lines, thus obtaining their support from the community in a variety of ways. Likewise, if in the plant society all the individuals were alike, or even of the same species, all could not be indefinitely supplied with the necessities of life. But with some kinds of plants needing certain soil and water elements, and other kinds needing other things, the members of the society live together and prosper fairly well, since all do not demand the same thing from the soil or water in which they grow. Notwithstanding this fact of the usual diversity of individuals in a plant society, there are many cases of massing

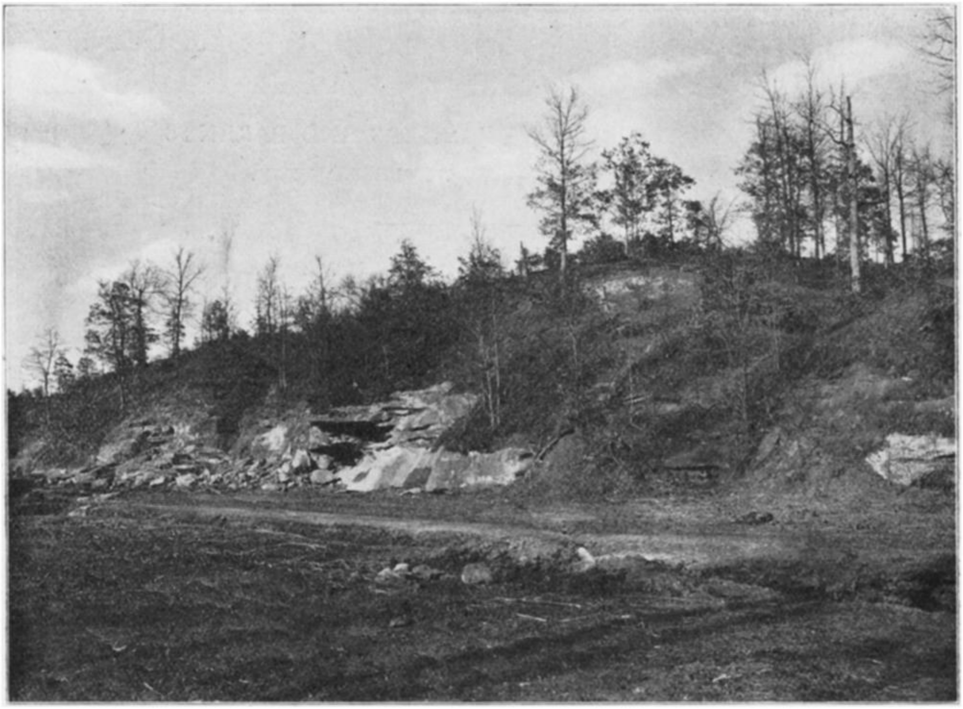

FIG. 1. A rock cliff where plants are fighting for their lives by trying to hold the soil. Where there are no plant roots the soil is readily removed by the action of water.

of members of a single species to the exclusion of all others. Such conditions are well illustrated in some pine and water lily societies.

As suggested above, the conditions of soil, water, air, and other elements of a given region have very much to do with determining the structure of the plants living in that region. On the other hand, the plants have much to do with determining the environment. This is admirably illustrated by a consideration of some of the morainic swamp regions, many of which are to be found in various places throughout the country formerly covered by the glaciers. At the time of the deposition of the terminal moraines left by the rapid recession of the great glaciers, there were formed basins of various sizes, many of which were left with no natural means of drainage, and consequently became ponds or lakes. During the earlier part of the life of these ponds or lakes, the water from the higher surrounding regions ran down the slopes, and as it ran, broke loose and carried with it parts of the earth or stone over which it flowed. These materials carried down by the water were deposited in the bottom of the pond, and by this filling process contributed greatly toward removing the body of water.

When the pond was comparatively young, however, the plants became established in all these regions, whose alteration affected the size, shape, and depth of the basin; and with the advent of these plants came some interesting occurrences in the life history of the pond. The plants which grow on the surrounding land send their roots deep into the soil as well as throughout its surface. Soon the soil is filled with mats of roots which serve to hold it and to keep it from being carried away by the action of the water. A good illustration of how the soil may be held against the action of the water is shown in Figure 1. In this view, which, however, is not of a morainic slope, it will be noticed that where there are no plants the soil has been carried away, thus leaving the land exposed.

On slopes which are not so steep, plants are much more successful in holding the soil, and in the regions surrounding most of the basins formed by the debris of the terminal moraine, the amount of erosion is not great during an average year. It is obvious then that one important stage in the life history of a pond or lake is that of rapid filling with earth as the result of a correspondingly rapid erosion of the exposed land. This stage ends when large numbers of plants have become well established on the surrounding land, though it must not be supposed that all erosion and consequent filling ends at this time.

Probably while these plants were becoming established on the land, the water plants made their appearance. Usually some of these water plants float in or upon the water, having nothing to hold them to any definite soil region. These form the free swimming water plant societies, some members of which are shown in Figure 2. Others may have their leaves upon, above or beneath the surface, and their roots in the soil, thus giving them relatively permanent positions. This condition is well illustrated by the usual habit of the ordinary white water lily. At the margin of the pond in the shallow water, and in the very wet earth outside the water, are found plants commonly spoken of as swamp or marsh plants. They are frequently represented by the water plantain, the bur-reed, the rushes, and the cat-tails. These plants, so far as concerns their roots, must be adapted to the same conditions as those of the plants mentioned in the water lily group, while their stems and leaves have many of the determining conditions found with dry land plants. By a more extended study we should find here some interesting and striking adaptations worked out by these plants which are adapting themselves to two groups of conditions, i. e., those of dry land plants for the leaves and at least parts of the stems, and the conditions of water plants for parts of the stems and the roots. In Figure 2 the fringe about the pond made by the marsh plant society is clearly shown.

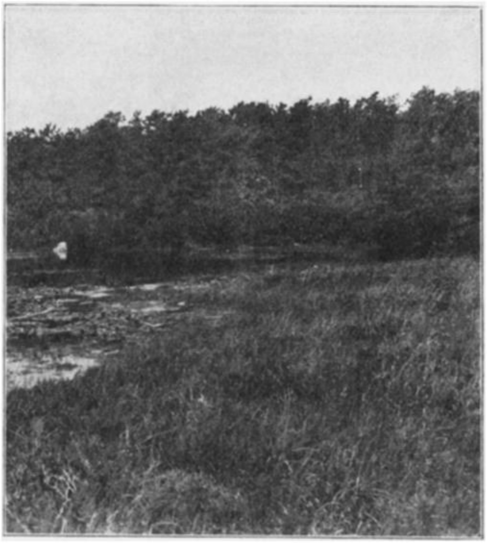

FIG. 2

A pond being obliterated by plants. In the water are water lilies and pond scums. Along the margin of the water the sedges and their crowd are encroaching. Following them are the shrubs and trees.

Back of this society of fringe plants there usually grows a society made up of a number of such shrubs as the willow and alder brush, while back of these will be found the trees or meadows (Figs. 2 and 3). These groups of plants from the free swimming society to the tree or meadow society may pass from one to the other by

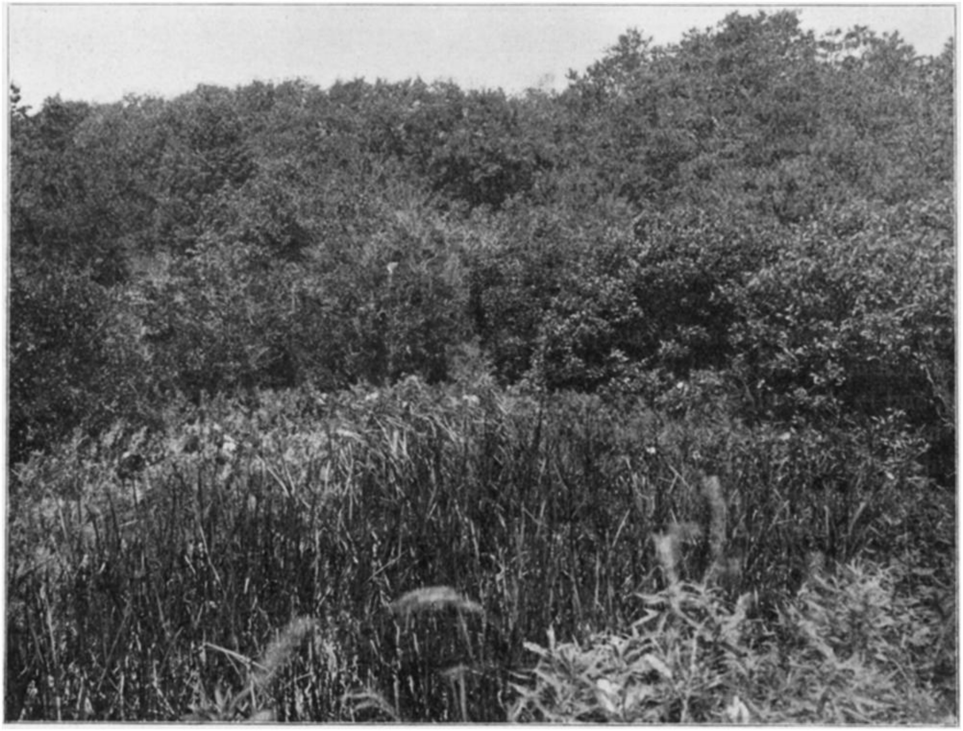

FIG. 3. A part of an old swamp, showing three of the four societies of plants interested in reclaiming it. Below, the sedge and cat-tail society, with which are seen fern plants. Back of this is the shrub society, and following the shrubs are the trees.

insensible gradations. Usually, however, the line of demarkation between the various societies is fairly clear, as will be seen by an examination of the accompanying figures.

A study of the ways in which these various groups affect each other and their environment will afford some interesting problems to those persons favorably located. The free swimming plants, and other water plants out from the water's margin, grow, build up their bodies, and die. Their dead bodies fall to the bottom of the pond, where they decay. Year after year this process goes on, gradually decreasing the depth of the pond, and would eventually, even if unassisted, result in the obliteration of the pond as such. But around the margin the marsh plants are growing, forming thick masses. These build up their soil in at least two ways. The dead plant bodies as they decay add an appreciable amount annually. Furthermore, currents of water running into the pond from adjacent regions are checked by the fringe of marsh plants, and being checked tend to deposit here large quantities of the earth they carry. It is evident that here is a region of rapid soil building, and that this region pushes inward with relative rapidity, year after year diminishing the size of the body of water. The willows and their crowd which follow the marsh society grow and decay, and give way after a time to the trees. Such trees as are best adapted to wet soil, as the cottonwood, are in the forefront of the tree society, just as the best adapted shrubs, notably the willows, are in advance of that group, pushing forward the most tardily adapted marsh plants.

Finally this process has been carried on until the water begins to disappear from the pond, when, for at least some of the plants, a new problem arises. When the total annual encroachment of the society without was slight, it was not difficult for the free swimming plants to move sufficiently to obtain favorable growing places. But when the last of the water region has been occupied by the sedges, rushes, cat-tails, and their kind, the free swimming plants are no longer able to move slight distances and obtain freedom and the water habitat to which they are adapted. When any such great change in the environment of a plant, or any other organism, occurs, and the plant is unable to change the environment, one of three possibilities may be accepted. First, if the plant can migrate to new and favorable environment, it may prosper. Second, if it can readapt its structure to the changing conditions, it may remain, and possibly prosper. Third, failing to do either of these, it must cease to exist. The free swimming plants of the ponds must usually accept the third of these possibilities.

Such is not always so readily true with the water plants having roots. In Figure 4 is shown an old lily pond from which the water has disappeared. The lilies which formerly grew here in the water, as the conditions changed have so adapted their leaves, stems, and roots that they now grow in the so-called dry land with great luxuriance. In August, 1900, hundreds of these plants were seen in full flower with the leaf and flower stalks frequently three and one-half feet in length. Since this lily pond had become dry, it is obvious that these plants have accepted the second of the possibilities open to them.

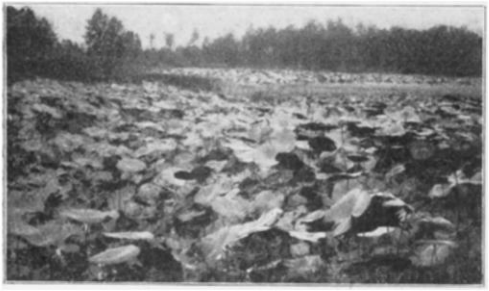

FIG. 4

An old lily pond. The leaves, stalks, and seed-pods show in the picture. This region was formerly covered with water the entire year. Now that the pond has become dry land, the lilies must learn to live in new conditions or die.

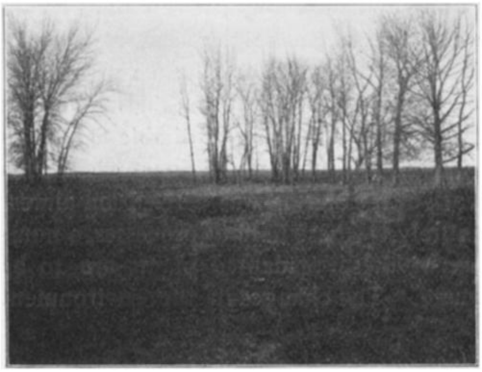

FIG. 5

An old pond almost entirely reclaimed. The incomplete circle of cottonwood trees was once at the margin of the water. The reclaiming of this pond was done almost entirely by natural means, since artificial drainage has been used in this region but a few years.

The last stage in reclaiming these regions by plants is brought about by continued building up of the soil until it is no longer a propitious environment for any of the plant societies mentioned except the last. Such a condition is shown in Figure 5, in which case the incomplete circle of cottonwood trees marks the point of a former margin of the pond. The interior, though somewhat low, has a few of the sedges remaining from the marsh society, but is well occupied by meadow grass, which is a dry land plant. In many places where these swamps formerly existed one may see plants such as the cottonwoods, willows, and swamp grasses remaining, and by their presence telling an interesting story as to what has been the history of their homes.

These plants are relatively plastic, and were able to make the necessary adjustments as the pond became a swamp, and the swamp passed through its various stages until it became a tillable field. In many of our farming regions, where this work of reclaiming was carried on almost entirely by these natural processes, a number of these readapted plants are to be found. The changes in the environment took place sufficiently slowly to make adaptations possible. In many other places artificial drainage and artificial removal of existing plant societies have made the changes in the environment so abrupt that plants could not make the adaptations necessary for growth in these new conditions, and there is little remaining besides the structure and contour of the land to suggest the former conditions.

Principles of Correlation

Francis W. Parker

I. A fundamental error in education is the isolation of subjects on the lines of conventional classification, thus attempting to separate, by teaching, the thought of one particular subject from the thought of other subjects to which it is organically related.

The educative value of one subject is primarily determined by its organic relations to all other subjects. It is therefore impossible to appreciate, or even to understand, any subject without knowing that it is but a part of the whole, and that each part penetrates the whole. Each subject has definite relations to all subjects; thus Physics and Chemistry are the sciences of ever-changing matter, and therefore intrinsic to the study of all other subjects. The distribution of heat, air, moisture, plant and animal life, over the earth's surface, cannot be profitably studied without a knowledge of the earth's surface.

II. **Unity of Subjects:** 1. Man and Nature comprehend all subjects. These two are one in the Creator and the created. The essence of the knowledge of Man and Nature is law; and law has its function in life. Life, then, is the central subject of study.

III. **Examination of Correlated Subjects:** INORGANIC MATTER. Physiography presents the knowledge of the earth's structure and surface.

Geology is the history of the continual changes in the earth's rock envelope or crust. Geology, then, is the history of Physiography: Physiography presents the effects and Geology the causes.

Mineralogy presents the knowledge of the nature and composition of the rock crust or of the material which is constantly undergoing geological and physiographical changes.

Unity: The present surface (Physiography), the changing surface (Geology), the material which changes (Mineralogy).

Meteorology teaches the action of heat, moisture, and air upon and in the earth's crust; and their distribution over the earth's surface. Heat, moisture, air, are the causes of changes in the rock crust (Geology), in the surface of the earth (Physiography), and in the composition of rock material (Mineralogy).

Unity: Causes of changes in the earth's crust (Meteorology), the changes (Geology), the intrinsic effects of changes (Mineralogy), the surface effects of changes (Physiography).